REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1, 2 and 4-9, and 21-32 are presently active in this case, Claim 1 amended and Claim 3 canceled by way of the present amendment.

In the outstanding Official Action, Claims 1, 2, 4-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,493,855 to Sachdev; Claims 1, 4-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. 2005/0051820 to Stojakovic; Claims 1, 3-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,316,167 to Angelopoulos in view of U.S. Patent No. 5,114,529 to Masuyama and Claims 21-32 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Stojakovic in view of U.S. 2003/0022526 to Vyvoda.

Applicants first note that Claim 1 is amended herein to include the subject matter of Claim 3, and the rejection of Claim 3 is traversed. Because Claim 1 is amended to include only subject matter already examined by the Examiner, Applicant submits that the present Amendment After Final should be considered and entered at least for purposes of appeal.

Turning now to the merits, Applicants' invention is directed to a method of treating an antireflective layer in a lithographic structure. As discussed in Applicants' specification, antireflective coatings provide substantial improvement to lithographic structures for forming small features in a semiconductor substrate, but can be damaged during processing steps and otherwise may not provide adequate etch resistance to function as a hard mask. One embodiment of Applicants' invention provides an oxygen plasma treatment of a tunable anti-reflective coating layer in order to enhance its use as a hard mask.

Specifically, Applicants' Claim 1, as amended recites a method of preparing a structure on a substrate including preparing a film stack having a thin film, a hard mask

formed on the thin film, and a layer of light sensitive material on the hard mask wherein the hard mask includes a tunable anti-reflective coating formed within the film stack having a structural formula of R:C:H:X, wherein R is selected from the group consisting of Si, Ge, B, Sn, Fe, Ti, and combinations thereof, and wherein X is not present or is selected from the group consisting of one or more of O, N, S, and F. Also recited is forming a pattern in the layer of light sensitive material, transferring the pattern to the hard mask to form a patterned mask, and removing the layer of light sensitive material. A surface layer of the patterned hard mask is then treated in order to chemically alter the surface layer to a depth of at least 10 Å, and the pattern is transferred to the thin film using the patterned hard mask as an etch mask.

The cited reference to Sachdev et al. discloses a lift-off mask process that uses a plasma polymerized organosilicon film to deposit metal on a substrate. As seen in Figures 1A-1H of this reference, the process includes forming a base layer 6 of soluble organic polymer on a dielectric, forming an organosilicon film 7 on the base layer, and forming resist 8 on the organosilicon film. An opening is then etched within the layers 6, 7, and 8, metal 15 is formed on the dielectric 2, and the base layer 6 is treated with a solvent in order to remove or "lift off" the barrier film 7. Thus, Sachdev et al. does not disclose an anti-reflective coating at all. The cited reference to Stojakovic et al. discloses a fabrication process for MTJ devices, in which a photoresist 72 and antireflective coating 70 are used to create a hard mask 42 for forming the MTJ device. However, as acknowledged by the Office Action, the antireflective coating 70 is not treated by an oxygen plasma.[1] Thus, neither Sachdev et al. nor Stojakovic et al. disclose treating a tunable antireflective coating layer as now required by Applicants' Claim 1. Indeed, Applicants note that the final Office Action did not cite these references for this feature, which was previously included in dependent Claim 3.

[1] See Office Action at page 6, paragraph 11, lines 9-14.

The Official Action cites the combination of Angelopoulos et al. and Masuyama et al. as teaching treatment of a tunable anti-reflective coating as now required by Claim 1. Specifically, the final Office Action admits that Angelopoulos et al. does not disclose treating an anti-reflecting coating with an oxygen plasma, but concludes that a conventional oxygen plasma ashing step such as that shown in Masuyama et al. could be used to remove the resist coating in Angelopoulos et al., which would result in treatment of the anti-reflective coating. Applicants submit, however, that even assuming the use of an oxygen plasma to remove the resist coating in Angelopoulos et al., any exposure of the anti-reflective layer to the oxygen plasma would be purely incidental and would not be a treatment of a surface layer of the tera coating to chemically alter the surface layer to a depth of at least 10 Å, as required by Claim 1. In this regard, Applicants note that the treatment depth of 10 Å cannot properly be considered a result effective variable. First, there is no indication in either Angelopoulos et al. or Masuyama et al. that the anti-reflective coating is intentionally treated by an oxygen plasma at all. That is, the "result" of improved etch resistance for the anti-reflective coating is not disclosed in the references. Further, since any exposure to the oxygen plasma is incidental, there is no "effective variable" of treatment depth in Angelopoulos et al. Thus, the combination of Angelopoulos et al. and Masuyama et al. does not disclose the treating step of Claim 1.

Even assuming that it can be gleaned from these references that the anti-reflective coating is treated, such treated layer is not used as an etch mask as also required by Claim 1. As seen in Figure 10 of Angelopoulos et al., the resist is used as a mask to etch the entire feature and the RCHX coating is used to provide antireflective properties only. Further, in Figure 11, the resist is used to etch an oxide hard mask, and a BARC layer provides antireflective properties for this process. The, resist and BARC layers are then removed and

the oxide is used to provide further etching. Thus the BARC layer is also not used as a hard mask.

Finally, Applicants submit that there is no motivation to combine Angelopoulos et al. and Masuyama et al. to arrive at the present invention. It is Applicants that have discovered that a tunable anti-reflective layer may provide insufficient etch resistance. Indeed, Applicants' specification as originally filed discussed the Angelopoulos et al. reference as disclosing TERA layers generally, but concluded that the TERA layers have inferior mask properties. It is this realization that motivated Applicants to treat a tunable anti-reflective layer according to the present invention. None of the cited references disclose this or any other motivation for treating tera layers.

For the reasons discussed above, independent Claim 1 patentably defines over the cited references. As the remaining dependent claims depend from Claim 1 in this case, these dependent claims also patentably define over the cited references. Nevertheless, Applicants note that Claims 29-32 each recite an over-treatment exposure time of a hard mask after removal of a light sensitive layer. Even assuming that the combination of Angelopoulos et al. and Masuyama et al. disclose exposure of a TERA layer to an oxygen plasma, as discussed above any treatment of the TERA layer is purely incidental. Therefore, this combination cannot disclose an over treatment step as required in Claims 29-32. This provides an additional basis for patentability over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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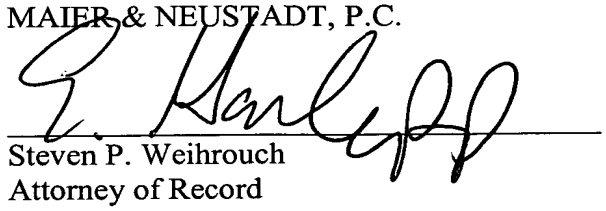

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